

## Claims

ART 34 AND 1  
BY

1. A receiver for receiving a signal comprising a carrier modulated with a known training sequence comprising:
  - 5 a frequency offset estimation unit for receiving the signal and obtaining an estimate of a carrier frequency offset from an autocorrelation signal obtained by autocorrelation of the part of the received signal containing a known training sequence;
  - a frequency offset compensation unit for compensating the received signal with the frequency offset obtained from the frequency offset estimation unit to form a compensated received signal, and
  - 10 a time reference determining unit for obtaining a timing reference for the received signal by cross-correlation of the compensated received signal with a known training sequence.
- 15 2. The receiver according to claim 1, wherein the time reference determining unit is adapted to obtain a first timing reference for the received signal by autocorrelation of the received signal and a second timing reference for the received signal by the cross-correlation of the compensated received signal with the known training sequence.
- 20 3. The receiver according to claim 1 or 2, wherein the frequency offset estimation unit comprises means for determining a phase shift in the autocorrelation signal of the received signal.
4. The receiver according to any previous claim, wherein receiver comprises means to detect a characteristic curve indicative of a known training sequence in the phase of the autocorrelation signal.
- 25 5. The receiver according to any previous claim, wherein the receiver comprises means to detect a characteristic curve indicative of a known training sequence in the amplitude of the autocorrelation signal.
6. The receiver according to claim 4 or 5, wherein the characteristic curve includes peaks and/or troughs and threshold values are used to detect peaks and troughs.
- 30 7. The receiver according to claim 6, wherein the threshold values are set dynamically.
8. The receiver according to any of claims 3 to 7, wherein the frequency offset estimation unit comprises means for determining the carrier frequency offset from

the phase shift.

9. The receiver according to any previous claim, wherein the receiver comprises means to determine a sign of the CFO from the phase of the autocorrelation signal from a known sequence.
- 5 10. The receiver according to claim 9, wherein the receiver has means for determining a phase shift in the autocorrelation signal from a further known sequence of the received signal.
11. The receiver according to any previous claim, wherein the time reference determining unit comprises means to determine a characteristic curve indicative of a known training sequence in the amplitude of the autocorrelation signal.
- 10 12. The receiver according to any previous claim, wherein the time reference determining unit comprises means to determine a characteristic curve indicative of a known training sequence in the phase of the autocorrelation signal.
13. The receiver according to any previous claim, wherein the time reference determining unit comprises means to determine a characteristic curve indicative of a known training sequence in the amplitude of the cross-correlation of the compensated received sequence with the known training sequence.
- 15 14. The receiver according to claim 13, wherein the characteristic curve includes peaks and/or troughs and threshold values are used to detect peaks and troughs.
- 20 15. The receiver according to claim 14, wherein the threshold values are set dynamically.
16. The receiver according to any previous claim, wherein the receiver is adapted to output the timing reference obtained from the received signal by autocorrelation of the received signal if the timing reference obtained by cross-correlation of the compensated received signal with the known training sequence is not present.
- 25 17. The receiver according to claim 16, wherein the receiver is adapted to otherwise output the timing reference determined by cross-correlation of the received signal.
18. The receiver according to claim 16, wherein the receiver is adapted to compare the timing reference for the received signal obtained by cross-correlation of the compensated received signal with the known training sequence when present and the timing reference determined by autocorrelation of the received signal, and to output a reset signal if the two timing references differ by more than a threshold value and otherwise to output the timing reference for the received signal obtained
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by cross-correlation of the compensated received signal with the known training sequence.

19. The receiver according to any previous claim wherein the timing reference determining unit is adapted to determine a symbol timing from a correlation peak in the cross-correlation of the received signal with the training sequence.

5 20. The receiver according to any previous claim, wherein the received signals also contain a cyclic prefix, further comprising: means for obtaining an accurate value for the carrier frequency offset by autocorrelation of the cyclic prefix with the received signal.

10 21. An OFDM telecommunications system including a receiver according to any of the claims 1 to 20.

22. A method for processing a received signal comprising a carrier modulated with a known training sequence, comprising:  
obtaining an estimate of a carrier frequency offset from an autocorrelation signal  
15 obtained by autocorrelation of the part of the received signal containing a known training sequence;  
compensating the received signal with the obtained estimate of the frequency offset to form a compensated received signal, and  
obtaining a timing reference for the received signal by cross-correlation of the  
20 compensated received signal with a known training sequence.

23. A receiver for receiving a signal comprising a carrier modulated with a known training sequence comprising:  
an autocorrelation unit for generating a phase and an amplitude autocorrelation signal by autocorrelation of a known sequence in the received signal,  
25 a time reference determining unit for obtaining a timing reference for the received signal, the time reference determining unit comprising means to detect synchronisation using both the phase and amplitude signals.

24. A method for obtaining a timing reference from a received signal comprising a carrier modulated with a known training sequence comprising:  
30 generating a phase and an amplitude autocorrelation signal by autocorrelation of a known sequence in the received signal, and obtaining a timing reference for the received signal by detecting synchronisation using both the phase and the amplitude signals.

25. A receiver for receiving a signal comprising a carrier modulated with a known training sequence comprising:

an autocorrelation unit for generating an autocorrelation signal by autocorrelation of a known sequence in the received signal,

5 a time reference determining unit for obtaining a timing reference for the received signal, the time reference determining unit comprising means to detect synchronisation by detecting at least two synchronisation conditions in the autocorrelation signal.

26. A method for obtaining a timing reference from a received signal comprising a carrier modulated with a known training sequence comprising:

10 generating an autocorrelation signal by autocorrelation of a known sequence in the received signal, and obtaining a timing reference for the received signal by detecting synchronisation using at least two synchronisation conditions in the autocorrelation signal.